

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

PGC0225 – GENERAL CHEMISTRY

(Foundation in Life Sciences students only)

25 October 2019
9.00 a.m – 11.00 a.m

(2 Hours)

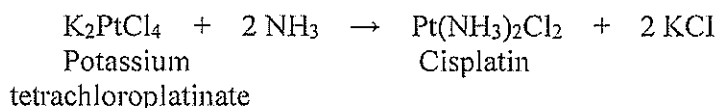
INSTRUCTIONS TO STUDENTS

1. This question paper consists of **5** pages with **5** questions only.
2. Answer **ALL** questions.
3. Please write all your answers in the answer booklet provided.
4. Distribution of marks for each question is given.
5. Calculator is permitted.

Instructions: Answer ALL questions.

Question 1 [10 marks]

- a. Cisplatin, an anticancer agent used for the treatment of solid tumors, is prepared by the reaction of ammonia with potassium tetrachloroplatinate:



Assume that 10.0 g of K_2PtCl_4 , and 10.0 g of NH_3 are allowed to react.

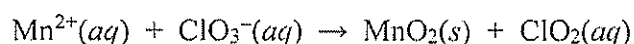
[Molar mass of: $\text{K}_2\text{PtCl}_4 = 415.3 \text{ g/mol}$; $\text{NH}_3 = 17 \text{ g/mol}$; $\text{Pt}(\text{NH}_3)_2\text{Cl}_2 = 300.1 \text{ g/mol}$]

- (i) Which reactant is limiting, and which is in excess? [2 marks]
- (ii) How many grams of the excess reactant are consumed, and how many grams remain? [1 mark]
- (iii) How many grams of cisplatin are formed? [1 mark]

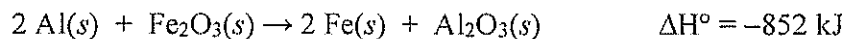
- b. Stomach acid, a dilute solution of HCl in water, can be neutralized by reaction with sodium hydrogen carbonate, NaHCO_3 .

- (i) Write the balanced equation for the chemical reaction mentioned above. [1 mark]
- (ii) How many milliliters of 0.125 M NaHCO_3 solution are needed to neutralize 18.0 mL of 0.100 M HCl ? [1 mark]

- c. Write unbalanced half-reactions (indicate the change of oxidation number) for the following net ionic equation: [2 marks]



- d. How much heat (in kilojoules) is evolved when 5.00 g of aluminum reacts with a stoichiometric amount of Fe_2O_3 ? [2 marks]
[Atomic mass: $\text{Al} = 27.0$]



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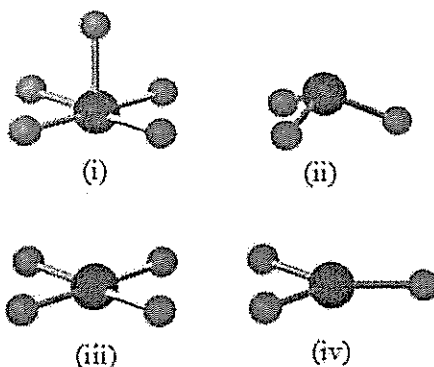
Question 2 [10 marks]

- a. What is the energy (in kilojoules per mole) of photons of radar waves with $\nu = 3.35 \times 10^8$ Hz? [Planck's constant, $h = 6.626 \times 10^{-34}$ J·s] [2 marks]
- b. State which of the following combinations of quantum numbers are not allowed. Explain your answer.
- (i) $n = 3, l = 0, m_l = -1$ [2 × ½ mark]
(ii) $n = 4, l = 4, m_l = 0$ [2 × ½ mark]
- c. According to the aufbau principle, which orbital is filled immediately after each of the following in a multi-electron atom?
- (i) 4s [½ mark]
(ii) 3d [½ mark]
- d. Like the other halogens, astatine is a nonmetal. It is located in Group VII, after iodine. However, little is known about the chemistry of astatine (At) from direct observation, but reasonable predictions can be made.
- (i) Is astatine likely to be a gas, liquid, or a solid? [½ mark]
(ii) What colour is astatine likely to have? [½ mark]
(iii) Is astatine likely to react with sodium? If so, what is the formula of the product? [2 × ½ mark]
- e. Write a balanced equation for the reaction of lithium with each of the following substances.
- (i) H₂ [1 mark]
(ii) H₂O [1 mark]
(iii) O₂ [1 mark]

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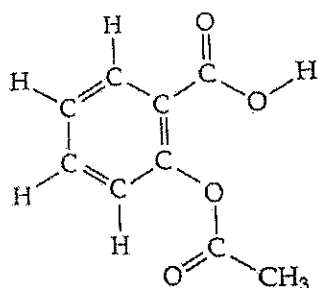
Question 3 [10 marks]

- a. What is the geometry around the central atom in each of the following molecular models? [4 × ½ mark]



- b. Draw the Lewis structure of bromine pentafluoride. [1 mark]

- c. Aspirin has the following structure. Indicate the number of σ bonds and π bonds in the molecule, and state the hybridization of each carbon atom. [2 marks]



- d. Identify the likely kinds of intermolecular forces in the following substances:

- (i) HCl [1 mark]
(ii) CH₃CH₃ [1 mark]
(iii) CH₃NH₂ [1 mark]

- e. Substance X has a vapor pressure of 100 mm Hg at its triple point (48°C), a melting point of 50°C and a boiling point of 100°C at 760 mm Hg. Sketch the phase diagram for X, including labels for the different phases, the triple point, the melting point, and the boiling point.

[2 marks]

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Question 4 [10 marks]

a. The iodide ion reacts with hypochlorite ion in the following way:

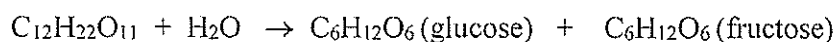


This rapid reaction gives the following data:

Experiment	$[\text{OCl}^-] \text{ (M)}$	$[\text{I}^-] \text{ (M)}$	Initial Rate (M/s)
1	1.5×10^{-3}	1.5×10^{-3}	1.36×10^{-4}
2	3.0×10^{-3}	1.5×10^{-3}	2.72×10^{-4}
3	1.5×10^{-3}	3.0×10^{-3}	2.72×10^{-4}

- (i) Determine the rate law for this reaction. [3 marks]
(ii) Calculate the rate constant. [1 mark]
(iii) Calculate the rate when $[\text{OCl}^-] = 2.0 \times 10^{-3} \text{ M}$ and $[\text{I}^-] = 5.0 \times 10^{-4} \text{ M}$. [1 mark]

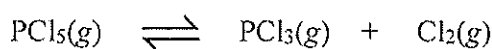
b. Sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$, reacts slowly with water in the presence of an acid to form two other sugars, glucose and fructose.



The reaction is first order and has a rate constant of $6.2 \times 10^{-5} \text{ s}^{-1}$. Suppose that the initial concentration of sucrose in the solution is 0.40 M .

- (i) What will the sucrose concentration be after 2 hours? [1½ marks]
(ii) How many minutes will it take for the sucrose concentration to drop to 0.30 M ? [1½ marks]

c. The equilibrium constant K_p for the decomposition of phosphorus pentachloride to phosphorus trichloride and molecular chlorine is found to be 1.05 at 250°C . The reaction is shown below.



- (i) If the equilibrium partial pressures of PCl_5 and PCl_3 are 0.875 atm and 0.463 atm , respectively, what is the equilibrium pressure of Cl_2 at 250°C ? [1½ marks]
(ii) Write the expression for K_c for the above reaction. [½ mark]

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Question 5 [10 marks]

- a. Nitric acid (HNO_3) is used in the production of fertilizer, dyes and drugs. Calculate the pH of a HNO_3 solution having a hydrogen ion concentration of 0.76 M . [1½ marks]
- b. What is the conjugate base of
- (i) HClO_4 [½ mark]
 - (ii) PH_4^+ [½ mark]
- c. A student prepared a 0.10 M solution of formic acid (HCOOH) and found its pH at 25°C to be 2.38.
- (i) Write the ionization equation of formic acid forming H^+ ions. [½ mark]
 - (ii) Calculate K_a for formic acid at this temperature. [4 marks]
- d. A sample of freshly pressed apple juice has a pOH of 10.24. Calculate the concentration of H^+ . [2 marks]
- e. Calculate the concentration of H^+ in a solution in which the concentration of OH^- is 0.001 M . [1 mark]

End of Paper